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UNITED STATES BUREAU OF MINES
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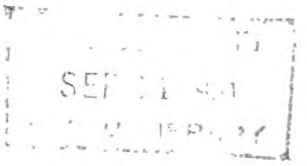
QUARTZ AND SILICA

PART I. - GENERAL SUMMARY



BY

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QUARTZ AND SILICA[1]

PART I - GENERAL SUMMARY

By R. M. Santmyers[2]

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FOREWORD

Quartz and silica not only occur in diversified forms in nature but find a multiplicity of uses in industry. The purpose of the present paper is to assemble brief summaries of the many widely differing industries engaged in the production and preparation of these minerals in their principal commercial forms. Due to the scope of the subject it was though advisable to divide the paper into three parts. Part I deals with the subject of quartz and silica in general. It also contains a flow sheet of silica from deposit to consumer (fig. 1). Part II covers the uses and other economic factors of quartz, quartzite, and sandstone, the varieties of silica found in consolidated form. Part III deals with sand and miscellaneous silicas such as tripoli and diatomite. A chart showing the major ramifications of these industries is presented herewith as an introduction to the more detailed discussion that follows.

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1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6472."

2 Mineral specialist, Rare Metals and Nonmetals Division, U. S. Bureau of Mines.

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For a more intensive study of many branches of the quartz and silica industries the reader is referred especially to Bulletin 266 of the United States Bureau of Mines, Technology and Uses of Silica and Sand, by W. M. Weigel. For annual statistics relative to silica and its products in the United States he is referred to the annual chapters of Mineral Resources of the United States, entitled "Silica," "Sand and Gravel," and "Abrasives." With respect to diatomite reference is made to Diatomite, by Paul Hatmaker, recently issued by the U. S. Bureau of Mines as Information Circular 6391. In preparing this paper the author has drawn freely from these sources as well as Marketing of Metals and Minerals, by J. E. Spurr and F. E. Wormser; Non-Metallic Minerals, Occurrence, Preparation and Utilization, by Raymond B. Ladoo; and Abrasives - Part I, Siliceous Abrasives, by V. L. Eardley-Wilmot, Report 573, Mines Brand, Department of Mines, Ottawa, 1927.

Acknowledgment is also made to the Foote Mineral Co., which has published in Foote-Prints (vol. 2 of 1929 and vol. 1 of 1930), comprehensive reviews of the uses of crystal quartz in the optical industry and as piezo-electric crystals.

HISTORY

The various forms of silica have attracted attention from the earliest times, and the water-clear crystallized variety was known to the Greeks as"krystallos" (clear ice), being supposed by them to have been formed from water by the intense cold of the Alps; hence the name "crystal" or more commonly "rock crystal," applied to this variety. The name quartz is an old German word of uncertain origin used by G. Agricola in 1529.

GENERAL DESCRIPTION

Silica or silica dioxide (SiO_2) either free or in combination with other elements constitutes 59.08 per cent of the lithosphere, and quartz alone represents fully 12 per cent[3] of all rocks. Next to the feldspar group quartz is the most abundant mineral in the earth's crust; and it appears in a greater number of varieties and modes of occurrence than any other mineral. Silica or quartz occurs in crystalline, cryptocrystalline, microcrystalline, and amorphous forms. The most common, however, is the crystalline form, which occurs as three minerals, quartz, tridymite, and crystobalite, and of these three tridymite and crystobalite are quite rare in nature.

As generally used the term quartz includes practically all sands, sandstone, quartzite, and rock or vein quartz. Quartz in turn is divided into numerous varieties, the physical appearance of each differing considerably from the other. The rock-crystal variety, when devoid of all flaws and water clear, has considerable application in the optical instrument industry.[4]

3 Clarke, F. W., The Data of Geochemistry: U. S. Geol. Survey Bull. 770, 1924, p. 34.

4 Weigel, W. M., Technology and Uses of Silica and Sand: Bull. 266, Bureau of Mines, 1927, p. 36.

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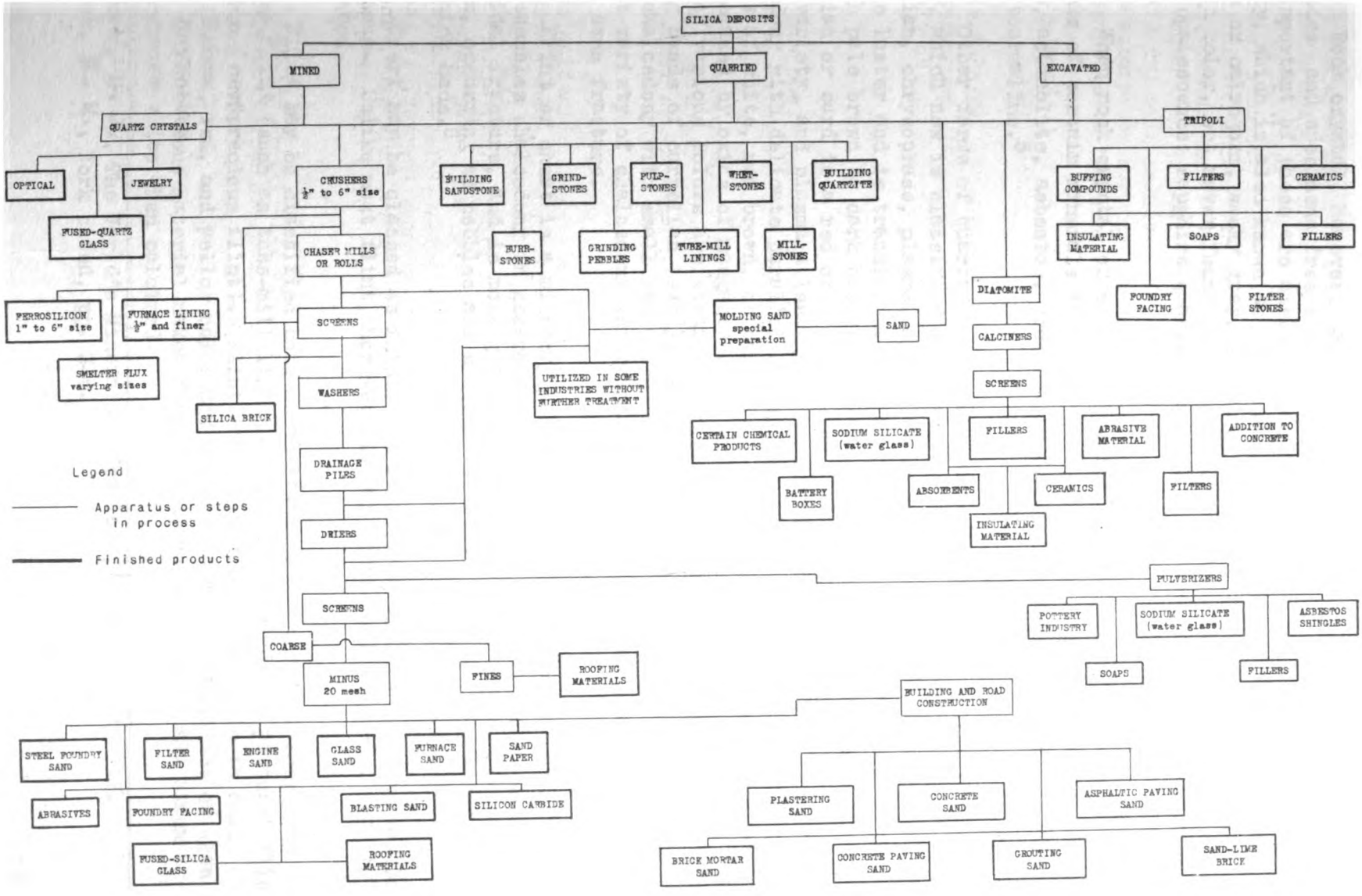

Figure 1.- Silica flow sheet from deposit to consumer (based in part on chart published by L. Heber Cole, Bull. 555, Canada Dept. Mines, 1923, pt. I, p. 5)

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Rock crystal, however, may appear in numerous colors and colored varieties and specimens free from flaws have some value as gemstones. The most important of these are amethyst, which is violet; citrine, the yellow variety, which is also known as occidental topaz or Spanish topaz; smoky quartz or cairngorm, smoky gray, brownish, or black; rose quartz, delicate rose in color, but never found as distinct crystals; milk quartz, white with milky opalescence; sapphire quartz, which is blue; and prase, which is leek green.

When rock crystal or sagenitic quartz has inclusions of needle-like crystals of certain minerals it may be used as a gem. Such minerals include rutile, actinolite, asbestos, crocidolite (cat's eye and tiger eye) and black tourmaline.[5]

Other forms of quartz having some value as gem stones include chalcedony, which now is classified as cryptocrystalline quartz and includes carnelian, chrysoprase, plasma, agate, onyx, and sardonyx. Chalcedony has a waxlike luster and is translucent to transparent; its color varies from white through pale brown to dark brown and black, though it is occasionally blue. Carnelian or sard is a red or brownish-red chalcedony, chrysoprase an apple-green variety, and plasma a leek-green or emerald-green variety. Agate is a chalcedony with delicate parallel bands of color or irregularly clouded color effects of white, red brown, or even blue, while moss agate contains mosslike forms caused by oxide of manganese. In onyx, another form of chalcedony, the bands of various colors are straight and parallel, while sardony is onyx containing bands of carnelian (sard). Another variety, bloodstone, is a dark-green chalcedony with small red dots, like drops of blood. Jasper is the compact variety of chalcedony intermixed with much iron oxide and clay and has an even fracture.

Flint or chert is a microcrystalline or colloidal form of quartz that resembles chalcedony in general appearance but is more opaque, has a conchoidal fracture, and is more granular. Flint is usually concretionary in form, occurring as pebbles and bowlders in other rocks but sometimes as very thick beds.[6]

Chert may be classed as flint, but it is usually less pure and may be calcareous. Unlike most flint, however, it may occur in thick beds, usually brecciated.

Flint may be classified both as to its uses and physical form into abrasive flint (such as tube-mill lining and grinding pebbles), potters' flint, and agate (semiprecious flint). Flint ranges in color from white to dull black. Brown, red, and yellow colorings are due to small quantities of iron oxide. Carbonaceous material makes flint black, as practically all black flint becomes white when calcined.

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5 Spencer, L. J., The World's Minerals: New York, 1916, pp. 115-116.
6 Weigel, W. M., Work cited, pp. 3-4.

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Quartzite is a metamorphosed sandstone differing, however, from sandstone in that the cementing material is secondary quartz, and the stone therefore has the appearance of massive quartz. It is one of the most useful forms of silica, as it is the raw material for virtually all the silica refractories and part of the silica abrasives made in the United States and is also used in some metallurgical processes and in the chemical industry as acid-tower packing material.

Sandstone is similar to quartzite in being composed of grains of sand cemented together but differs in that when the mass is fractured the fractures go around the grains rather than through them, as in quartzite. The common cementing materials are silica, iron oxide, calcium carbonate, and clay.[7] The economic value of a sandstone is largely fixed by the silica content, the strength and character of the cementing medium, the size of the individual sand grains, and (for building purposes) the color and the resistance to weathering.

Sand and gravel are unconsolidated aggregates of highly siliceous, usually quartzose, grains. These grains range in size from submicroscopic particles to material ordinarily called bowlders. The finer aggregates are known as sand and the coarser as gravel. The dividing line between sand and gravel is variously placed at from 0.1 to 0.25 inch.[8] Most sands and gravels consist largely of quartz grains and pebbles, but commercial products usually contain from very small to considerable quantities of impurities. For many purposes these impurities are not harmful, but sands for certain purposes, such as glass sand and molding sands, must conform to very rigid chemical specifications.

Tripoli is a white, finely granular, porous form of chalcedonic quartz having the general appearance of diatomite but containing no diatoms. It is generally regarded as a cryptocrystalline variety of quartz, but under low magnification it often appears to be amorphous.[9] In the United States there are two types of tripoli, and they differ so widely in physical properties as to require separate treatment and are used for different purposes. In most deposits the rock is soft enough to be crushed in the hand and is easily pulverized mechanically. Tripoli is sometimes called "soft silica" and also erroneously "silex."

In the amorphous state there are two forms of silica, opal and diatomite. The opal or amorphous hydrated silica is highly prized in certain colors as a gem. It is widely distributed as nodules and stalactitic masses in the cavities of volcanic rocks, deposits from hot springs, etc. It is deposited in a colloidal state.

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7 Weigel, W. M., Work cited, p. 8.
8 Ladoo, R. B., Non-Metallic Minerals, Occurrence, Preparation and Utilization: New York, 1925, p. 499.
9 Ladoo, R. B., Work cited, p. 641.

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Diatomite or as it is sometimes called, diatomaceous earth, the other form of amorphous silica, is composed almost entirely of the siliceous skeletons of microscopic aquatic plants known as diatoms, radiolaria, etc., of which several thousand different varieties have been recognized. It occurs as a light-colored, light-weight, finely granular, porous aggregate varying in texture from loosely coherent to compact.

Varieties of Silica

The following is a list of the more important varieties of natural free silica or quartz.[10]

A. Crystallized quartz with vitreous luster:
   1. Rock crystal or "crystal," the purest form of quartz, the crystals being colorless and water clear (Marmorsch diamonds, Bristol diamonds, Brazilian pebbles, etc.).
   2. Amethyst, violet.
   3. Citrine, yellow varieties; occidental topaz, Spanish topaz, etc.
   4. Smoky quartz and cairngorm, smoke gray, brownish or black.
   5. Rose quartz, delicate rose red (never found as crystals bounded by faces).
   6. Milk quartz, white with milky opalescence.
   7. Sapphire quartz, blue.
   8. Prase, leek green.

B. Quartz with enclosures:
   1. Avanturine-quartz, inclosing scales of mica, hematite, etc.
   2. Cat's eye and tiger eye (crocidolite), inclosing fibers of asbestos.
   3. Hairstone, needlestone (rutilated quartz), inclosing needles of rutile, actinolite, etc.
   4. Eisen kiesel, inclosing iron oxide and hydroxides.

C. Cryptocrystalline quartz (chalcedony), with waxy luster:
   1. Agate, with curved bands differently colored.
   2. Onyx, with straight bands differently colored.
   3. Carnelian, yellowish-red or orange.
   4. Sard, yellowish-brown.
   5. Chrysoprase, pale green.
   6. Plasma, dark green.
   7. Bloodstone or heliotrope, dark green with red spots.

10 Thorpe, Edward, A Dictionary of Applied Chemistry: London, 1924, vol. II, pp. 528-529.

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D. Compact varieties, with dull luster:
   1. Jasper.
   2. Flint.
   3. Hydian stone.
   4. Hornstone.
   5. Buhrstone (quartzite).

E. Amorphous.
   1. Opal.
   2. Diatomite.

PROPERTIES OF CRYSTAL QUARTZ

Physical Properties

Quartz is a very common, hard, brittle mineral with no cleavage; the fracture being typically conchoidal and on the rounded, shell-like surfaces of the fracture the luster is bright and vitreous. The degree of hardness (No. 7 on Moh's scale) is such that the mineral can not be scratched with a knife, and when an attempt is made a metallic mark is left on the stone. Quartz is a comparatively light mineral (specific gravity, 2.65) being only a little more than two and one-half times as heavy as an equal volume of water.

Crystal Structure

The rock-crystal form of quartz is a regular 6-sided (hexagonal) prism capped by a 6-sided pyramid. Sometimes the six pyramid faces are of equal size, although they may occur alternately larger and smaller, with a 3-fold arrangement. Additional faces are sometimes present. On each of the three alternate corners between the prism and pyramid occasionally there may be a small rhomboidal face, and sometimes also a small trapezoidal face between the latter and a prism face. According to the disposition of these extra faces the crystal may be classed as right handed or left handed.

A characteristic feature of quartz crystals is that the prism faces are nearly always more or less deeply striated or grooved horizontally; that is, they are marked by fine lines (growth lines) perpendicular to the edge of the prism.

OCCURRENCE

Quartz occurs as a primary and essential constituent of igneous rocks of acidic composition, such as granite, quartz-porphyry, and rhyolite, being imbedded in these either as irregularly shaped masses or as porphyritic crystals. In pegmatite (graphic granite) and granophyre it often forms a regular intergrowth with feldspar. It is also a common constituent as irregular grains in many gneisses and crystalline schists, quartz schists

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being composed largely of quartz. By the weathering of silicates silica passes into solution, and quartz is deposited as a secondary product in the cavities of basic igneous rocks.[11]

Vein quartz represents the end products of the intrusion and solidification of acidic plutonic igneous rocks, deposition taking place in fractures and fissures in the earth's crust. Extensive veins of quartz are also frequent in schistose rocks.

Being very resistant to weathering agencies quartz forms the bulk of sands and sandstones. Through weathering of the granites of gneisses the quartz grains are released, and when these grains are once more cemented by a deposit of secondary quartz sandstone or quartzite results. As distinguished from sandstone quartzite is free from pores and has a smooth surface; when fractured it breaks through the sand grains, whereas in sandstones the fracture passes through the cementing material, and the rounded faces of the grains are exposed, making the broken surface look rough or granular. The conversion of sandstone into quartzite is sometimes the work of percolating water under ordinary conditions, but more often results from heat and pressure.

Tripoli, a chalcedonic form of quartz, is derived either from the decomposition or alteration of chert or as a residual product from siliceous limestone from which the calcium carbonate has been leached out. Some investigators have voiced the belief that the deposits in southwest Missouri at least may have been laid down in their present form or are the result of recrystallization of colloidal silica.[12]

Diatomite, an amorphous form of silica, is found in bedded deposits on the bottom of bodies of either fresh or salt water. Minute organisms secrete silica much as mollusks secrete lime and thus build up their shells. These diatoms are unicellular, free-swimming plants belonging to a large group of algae. The cell wall or frustule of each minute individual consists of two shields or valves of siliceous material with elaborate and beautiful ornamentation.[13] When the organisms die the organic matter largely disappears, and the shells remaining gradually build up beds. Although it has been calculated that 1 cubic inch of diatomite contains not less than 40,000,000 independent shells beds 2,000 feet thick are known. Other beds several hundred feet thick cover several square miles.

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11 Clarke, F. W., Data of Geochemistry: U. S. Geol. Survey Bull. 770, 1924, pp. 364-365.

12 Weigel, W. M., Work cited, p. 10.

13 Thorpe, Edward, A Dictionary of Applied Chemistry: London, 1921, vol. II, p. 505.

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CLASSIFICATION BY USE

Being hard, tough, resistant to acids, refractory, and often transparent, quartz has physical and chemical properties that admirably fit it for use as an abrasive, for the manufacture of chemical ware, as a high-duty refractory material, and for numerous other uses which will be outlined briefly in the following pages. The chemical affinity of quartz for alkalies and other compounds is utilized in the manufacture of glass and the fluxing of certain ores.

The factors that determine the adaptability of a certain material for a specified use are both physical and chemical. Even in the form of sand and gravel reasonable freedom from impurities and rather careful classification as to size are demanded by the markets, and in the case of optical quartz the specifications are extraordinarily rigid and complex.

Table 1 shows the approximate physical and chemical properties of quartz and silica according to their classification by uses. These specifications are only general, and in no way are they to be thought as rigid as those promulgated by the American Society for Testing Materials, the United States Bureau of Standards, and trade associations interested in formulating such specifications.

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Table 1.- Physical and Chemical Properties of Quartz and Silica According to Classification by Uses

Classification by uses	Physical properties			Chemical properties
	Crystal or grain size and shape	Color	Hardness	Purity
Rock crystal (optical)	Single crystals and right or left handed, but not twinned.	Absolutely free of color, air or gas bubbles, flaws, cracks, etc.		Absolutely pure
Rock crystal (piezo-electric)	do Growth lines must show on at least 2 sides.	do		do
Fusing quartz	Single crystals or twinned, and either right or left handed.	do		do
Fusing silica (Rock crystal or glass sand)	do 100% through No. 20 screen. Not more than 5% through No. 100 screen. Well graded angular or round.	Opaque or clear		Approximately 99.3% SiO_2. Less than 0.02 Fe_2O_3 Less than 0.1 Al_2O_3
Ferrosilicon (vein quartz)	1" to 3" diameter, no fines.	Immaterial		97% or more SiO_2. 1% Fe_2O_3. Free from lime, phosphorus and arsenic.
(quartzite)	do	do		do
Fluxing quartz (vein quartz)	Fairly uniform in size.	do		May contain metal values. Low in iron, lime and magnesia.
(quartzite)	do	do		do
(sandstone)	do	do		do
Acid towers (vein quartz)	2" to 8" in size, averaging 4".	do		Free of impurities soluble in acids, such as iron and arsenic and contain no clay seams.

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Refractory (vein quartz)	3/8" to 1/2" in size	Immaterial		May contain metal values.
(quartzite)	do	do		do
(sand) for foundry parting	65% pass 325-mesh. 33% retained on 325-mesh. 20% retained on 200-mesh.	do		99 to 99.7% SiO_2. Low in iron, magnesia.
Silica brick (ganister)	8 to 10 mesh	do		About 98% SiO_2. Not more than 1½% alumina.
(quartzite)	do	do		do Bonding material in some form is added.
Fire or furnace sand (sand)	90-99% retained on 200 mesh, 1-10% pass 200 mesh, graded coarse to fine.	do		95% or more SiO_2. Bonding material in some form is added.
(sandstone)	All pass 3/8" screen.	do		do
(quartzite)	56% through 40 mesh 15% retained on 8 mesh.	do		do
Sodium silicate (sand)	All pass 20 mesh and be retained on 100 mesh. High-grade glass sand is suitable.	clear		99% SiO_2 and not over 1% alumina, 0.5% lime and magnesia combined and 0.1% iron.
Silicon carbide (sand)	All pass 20 mesh and be retained on 150 mesh. High-grade glass sand is suitable.	Immaterial		99-99.5% SiO_2 Traces only of lime, phosphorus and magnesia.
Fillers (wood) (quartz)	All pass 200-mesh and only about 7% retained on 325-mesh. Angular grains.	Free from color.		Low in iron and alumina.
(plaster & cement) (sand)	About 40% retained on 150-mesh and 40% passing 325-mesh.	do		do

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Ceramics (quartz)	Known as 140-mesh product.	Free from color.		98-99% SiO_2 0.014-0.1% Fe_2O_3. 0.1-0.7% Al_2O_3.
(sand)	do	do		do
Abrasives				
Sand paper (quartz)	Graded according to requirements. Angularity necessary.	Immaterial	Hard and tough	Immaterial
Compounds (quartz)	All pass 325-mesh Angularity necessary.	do	do	do
Tube mill lining (quartzite)	Uniform texture	do	Tough	High in silica and low in iron oxides.
Grinding pebbles (quartzite)	do	do	do	do
(flint)	Uniform texture and graded to size required.	do	do	do
Grindstones (sandstone)	Uniform texture, sharp and even grain.	do	Uniform hardness. Free from unsoundness.	Free from clay and other impurities.
Pulpstones (sandstone)	do	do	do	do
Whetstones (sandstone mica schists novaculite)	do	do	do	do
Abrasives (sand)				
Sand blasting	All retained on 100-mesh, 99-100 retained on 65-mesh. All pass 14-mesh. Either angular or round.	do	Hard and tough.	High in silica.
Wire saw cutting	Uniform grain size, 99-100% through 20-mesh, 95% through 70-mesh.	do	do	Reasonably pure.

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Building construction				
Paving sand	50-90% retained on No. 50 screen, 100% passing ¼" screen. Coarse grain predominating, angular.	Immaterial	Hard and tough	No organic impurities.
Asphaltic sand	95-100% pass No. 10 screen. 100% pass ¼" screen. Not more than 5% pass No. 200 screen. Angular.	do	do	Small amounts organic impurities allowed.
Grouting sand	100% pass No. 10 screen. 80% pass 20-mesh. 5% pass 200-mesh. Angular or round.	do	Hard	No organic impurities.
Bed sand	100% pass ¼" screen. Not more than 5% removed by elutriation. Well-graded coarse to fine. Angular or round.	do	do	Small amounts organic impurities allowed.
Concrete sand	100% pass 3/8" screen. 85% pass No. 4 screen. 50% pass No. 50 screen. Graded coarse to fine, coarse predominating.	do	Hard and tough	Reasonably free from impurities.
Brick mortar sand	100% pass ¼" screen.	Important for white joints.	Hard and tough	3% clay or silt allowed.
Plastering sand	80% retained on No. 8 screen, 6% pass No. 100 screen. Graded coarse to fine.	Reasonably free from color.	do	Not less than 80% silica, feldspar, dolomite, etc. Free from saline and organic impurities.

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Molding sand (sand)	Grain size according to requirements. Steel molding: 97-100% retained on 325 mesh, 96-100% retained on 200 mesh.	Immaterial	Immaterial	95-100% SiO_2. Low in iron, magnesia, alumina. No organic impurities.
Glass sand (sand)	100% through No. 20 screen, 5% through No. 100 screen. Angular or round.	Important according to color of glass.	do	95%+ SiO_2.
Filter sand	0.20-0.70 mm. 10% by weight fines & 90% coarse.	Immaterial	Immaterial	High silica content. Not over 2% combined lime & magnesia, calculated as carbonates. Free from organic impurities.
Engine sand	All through 10-mesh 55% held on 80-mesh 5% through 80-mesh Minimum of dust. Angular preferred.	do	do	Free from clay and clay lumps and organic matter.
Roofing materials (sand)	98% through 20-mesh 10% through 100-mesh Uniformly graded. Round grain preferred.	White	do	High in silica. Free from organic impurities, clay, iron, etc.
(quartz)	All pass 200-mesh.	Colorless	do	40% or higher SiO_2. Free from organic impurities, clay, iron, etc.
Sand-lime brick (sand)	15% pass 100-mesh. Well-graded coarse to fine. Angular preferred.	Colorless	do	Reasonably free of rubbish and other foreign material.
Dimension stone (sandstone)	Even texture. Low in porosity.	Immaterial	High crushing strength.	Good cementing material.

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PRODUCTION

Table 2 shows the quantity, value, and average value of the silica products produced, sold, or used in the United States from 1923 to 1929, inclusive, and includes figures for building sand, special sands, industrial gravels, vein and pulverized quartz, tripoli, diatomite, and abrasive quartz. These data do not, however, include sandstone and quartzite for dimension stone; neither do they include such bank and river sand and gravel as are consumed locally by small contractors or individuals. Some of the products included are not true silica, or are too impure to be classed as such, so that the total production and value can not be cited as those of true silica.

The statistics relative to quartz include only that produced from pegmatite dikes, from veins, and from quartzite. There is a considerable production of quartz and quartzite for use in road construction in the United States; it is not reported separately, however, as it is combined with all crushed-stone aggregate and is therefore not included in the table.

The figures showing the production of diatomite include some rottenstone, a soft, earthy substance resulting from the decomposition of an impure siliceous limestone. The output of rottenstone, however, is small and comes from only one locality, Lycoming County, Pennsylvania.

Under the heading Abrasive Quartz are included millstones, burrstones, and related quarry products, such as chasers, dragstones, and paving stones for chaser mills; grindstones and pulpstones; oilstones and other whetstones, hones, scythestones, and rubbing stones; and grinding pebbles and lining for tube mills.

Practically every State contributes silica in some form or other to the total output of the United States. This is especially true of sandstone, as nearly every State contains sandstone suitable for some commercial purpose.

Table 3 shows the sand and gravel sold or used by producers in the United States in 1929 by States and uses. This will give some idea of the ramifications of two of the important silica products produced in this country.

IMPORTS

Table 4 shows the quantity, value, and average value per ton of the imports of quartz and related silica products into the United States from 1923 to 1929, inclusive. Except for sand and gravel, which, however, comes mostly from Canada and is shipped into the United States by water, the products are mostly those having a somewhat higher value per ton, such as abrasive stones, or are of a special grade, such as tripoli and diatomite. The shipments of "Brazilian pebble," flawless rock crystal, are, as far as figures are available, from Brazil and Madagascar and amount to only a few tons each year.

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Table 5 — *Sand and gravel sold or used by producers in the United States in 1929, by States and uses*

State	Glass sand		Molding sand		Building sand		Paving sand		Grinding and polishing sand		Fire or furnace sand		Engine sand	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			44,482	$37,662	516,646	$154,451	539,585	$238,240					(1)	(1)
Arizona					127,401	111,395	43,644	43,288					8,780	$2,888
Arkansas	(1)	(1)	(1)	(1)	266,554	148,568	263,903	210,272	(1)	(1)			20,971	8,862
California	7,500	$37,000	58,080	118,376	3,701,485	1,554,495	3,128,264	1,267,770	25,070	$58,646	19,073	$25,846	111,710	47,819
Colorado			11,645	9,285	215,785	113,674	20,640	11,286					26,665	15,081
Connecticut			(1)	(1)	332,972	208,434	246,562	192,126	2,373	9,106				
Delaware			6,149	4,532	17,017	11,395	23,000	12,000	134	689			10,000	4,000
District of Columbia					(1)	(1)	(1)	(1)					(1)	(1)
Florida	(1)	(1)			271,152	112,883	287,712	136,286					(1)	(1)
Georgia	10,470	11,517	11,840	2,920	246,984	95,243	269,165	83,542	(1)	(1)			15,203	6,384
Idaho					(1)	(1)	19,471	7,640					(1)	(1)
Illinois	552,539	502,434	1,135,820	804,371	4,011,481	1,573,236	2,020,278	822,156	449,475	901,145	65,795	54,766	142,864	75,307
Indiana	(1)	(1)	407,008	290,880	1,431,223	619,625	1,929,114	856,249	(1)	(1)	(1)	(1)	129,569	47,710
Iowa			48,558	32,911	442,491	234,833	1,294,148	538,416	(1)	(1)			44,238	22,146
Kansas			15,016	10,371	1,050,317	608,983	991,381	538,691	5,546	2,902			63,070	35,113
Kentucky			22,282	37,051	465,472	276,921	283,502	159,712			(1)	(1)	14,839	11,404
Louisiana					253,427	87,814	525,532	217,049	(1)	(1)			(1)	(1)
Maine					67,609	40,990	(1)	(1)					(1)	(1)
Maryland	(1)	(1)	(1)	(1)	400,473	209,228	1,311,231	858,982	(1)	(1)			(1)	(1)
Massachusetts	210	1,080	40,732	42,145	1,353,782	938,387	356,129	215,499	(1)	(1)	(1)	(1)	79,240	59,233
Michigan	(1)	(1)	1,150,807	805,447	1,941,452	800,116	3,152,125	1,239,397	(1)	(1)	(1)	(1)	17,998	3,998
Minnesota			27,919	23,269	968,369	346,239	554,310	219,604	(1)	(1)			64,223	20,525
Mississippi					212,494	153,435	242,311	118,642	(1)	(1)			(1)	(1)
Missouri	128,141	178,581	82,970	59,095	1,244,725	855,727	1,277,630	880,184	(1)	(1)			32,837	20,832
Montana			68	50	40,203	37,108	22,648	15,362					161	86
Nebraska			(1)	(1)	636,548	251,189	92,176	47,578					15,950	5,290
Nevada	(1)	(1)	(1)	(1)			(1)	(1)						
New Hampshire					(1)	(1)	439,207	144,162						
New Jersey	166,822	267,757	731,246	908,513	1,888,164	1,111,738	2,044,357	1,105,122	67,319	168,143	81,546	109,837	75,348	33,738
New Mexico					60,881	53,886	(1)	(1)	270	400			(1)	(1)
New York	(1)	(1)	591,866	984,077	6,590,182	4,232,415	6,438,889	3,882,774	2,513	2,963	(1)	(1)	188,286	121,691
North Carolina			(1)	(1)	136,930	60,512	199,794	46,463					66,968	30,116
North Dakota					52,057	26,854	(1)	(1)						
Ohio	74,666	184,424	977,441	1,357,075	2,636,704	1,733,778	2,444,878	1,405,580	(1)	(1)	60,069	107,992	75,043	45,721
Oklahoma	22,872	40,026			752,080	388,995	644,940	306,434	(1)	(1)			20,849	13,804
Oregon					274,799	242,161	292,689	217,525					(1)	(1)
Pennsylvania	506,812	$1,011,063	432,632	$647,879	3,452,533	$3,300,615	2,426,304	$2,110,870	570,717	$664,910	101,373	$133,123	328,012	$355,027
Rhode Island			(1)	(1)	27,434	8,187	71,784	24,503	(1)	(1)				
South Carolina					116,233	30,237	304,209	98,169	(1)	(1)			(1)	(1)
South Dakota					58,529	32,380	91,770	22,199					1,407	705
Tennessee			10,464	8,958	542,181	336,662	580,924	353,940	48,961	87,182	(1)	(1)	36,134	20,084
Texas	1,500	487	3,320	10,835	1,114,962	637,394	1,485,330	792,514	235	625			78,344	35,443
Utah					111,732	56,661	55,672	30,834						
Vermont			2,264	457	(1)	(1)	26,821	24,2[illegible]	(1)	(1)			(1)	(1)
Virginia	70,101	145,990	17,816	29,609	172,650	104,808	477,893	184,932	13,349	14,582	(1)	(1)	131,697	63,395
Washington			1,540	5,034	668,057	366,497	304,864	139,153					67,672	34,134
West Virginia	498,729	1,049,281	(1)	(1)	345,490	322,554	379,627	344,645	(1)	(1)			251,156	216,174
Wisconsin			128,597	82,508	1,471,019	469,227	2,155,460	810,911	33,347	78,132	(1)	(1)	57,912	14,306
Wyoming					(1)	(1)	(1)	(1)					(1)	(1)
Undistributed [2]	184,315	378,881	236,771	662,363	462,344	258,208	1,047,628	167,465	417,155	374,227	112,823	52,295	134,725	104,550
	2,219,677	3,788,471	6,195,343	6,410,343	41,161,013	23,309,238	40,801,991	21,131,731	1,636,464	2,308,652	440,679	483,551	2,318,931	1,487,906
Average value		1.71		1.03		0.57		0.52		1.41		1.10		0.64

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Table 5 – ***Sand and gravel sold or used by producers in the United States in 1929, by States and uses*—Continued**

State	Filter sand		Other sands		Building gravel		Paving gravel		Railroad ballast gravel		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	400	$1,600	(1)	(1)	501,882	$304,569	699,106	$492,786	32,140	$4,660	2,371,545	$1,229,424
Arizona			556	$133	105,211	103,810	(1)	(1)	(1)	(1)	395,386	329,116
Arkansas			(1)	(1)	187,216	176,976	1,293,636	741,859	1,796,688	478,150	3,992,336	1,851,755
California	5,131	11,742	187,066	78,322	3,616,853	2,313,223	3,879,523	2,607,987	955,840	260,037	15,688,545	8,371,263
Colorado			4,598	2,008	259,512	194,153	171,859	105,028	272,162	42,192	982,866	492,587
Connecticut	540	337	84,769	38,709	92,275	93,388	83,873	17,222	(1)	(1)	850,390	566,410
Delaware	(1)	(1)	7,936	13,215	592	888	(1)	(1)			78,055	59,266
District of Columbia					(1)	(1)	(1)	(1)			(1)	(1)
Florida			(1)	(1)	117,050	98,432	73,483	55,269	20,751	16,808	788,298	422,409
Georgia	315	1,733	10,762	4,739	7,392	8,485	(1)	(1)	(1)	(1)	604,611	235,299
Idaho			(1)	(1)	46,021	28,932	140,397	125,403	396,925	57,272	661,993	243,173
Illinois	1,053	4,212	1,048,439	534,136	3,401,945	1,589,935	3,363,578	1,564,304	2,062,936	645,234	18,256,203	9,071,238
Indiana	(1)	(1)	465,111	112,749	1,144,734	749,303	2,907,477	1,820,461	2,457,721	1,028,953	10,901,798	5,528,832
Iowa	(1)	(1)	39,068	8,691	317,719	254,666	1,600,895	973,893	237,716	115,146	4,043,609	2,211,752
Kansas	1,472	1,976	78,486	36,342	108,965	56,783	914,149	556,002	161,381	32,736	3,389,783	1,879,899
Kentucky			(1)	(1)	481,291	294,349	898,947	742,434	(1)	(1)	2,350,430	1,581,501
Louisiana			45,086	18,812	578,054	502,802	1,114,748	901,748	605,943	333,178	3,138,673	2,069,024
Maine					120,491	121,801	1,534,666	135,994	412,666	93,756	2,861,271	447,140
Maryland					299,077	302,922	1,095,454	1,346,605	(1)	(1)	3,193,486	2,853,617
Massachusetts	2,328	4,556	4,822	6,144	858,139	971,277	1,736,237	1,104,276	664,102	144,322	5,114,188	3,503,576
Michigan			548,312	127,883	2,533,588	1,425,565	5,139,278	2,969,864	2,177,970	860,525	16,844,099	7,928,744
Minnesota	(1)	(1)	(1)	(1)	629,310	583,839	1,223,437	919,314	1,482,348	275,407	4,990,256	2,412,776
Mississippi					129,384	91,681	1,636,994	733,642	535,729	178,130	2,766,036	1,277,746
Missouri			(1)	(1)	829,630	632,667	1,578,684	1,275,175	421,012	213,635	5,775,729	4,291,164
Montana			113,065	28,363	332,436	150,751	62,440	37,710	1,866,401	398,377	2,446,422	667,827
Nebraska			(1)	(1)	1,087,975	643,746	1,211,342	822,898	320,204	81,132	3,370,513	1,857,065
Nevada					(1)	(1)	666,691	425,663	711,199	68,972	1,403,255	605,079
New Hampshire					38,254	31,707	1,119,515	968,379	(1)	(1)	1,976,781	1,223,371
New Jersey	30,039	80,725	12,723	11,136	752,762	930,241	856,166	864,378	14,006	15,277	6,721,498	5,585,285
New Mexico					59,321	62,320			203,166	49,269	337,768	177,368
New York	(1)	(1)	164,457	77,652	3,382,441	2,900,439	3,291,876	2,595,089	423,570	111,927	21,061,094	14,919,658
North Carolina			91,863	58,464	(1)	(1)	179,878	170,530	74,459	41,981	1,004,858	1,020,533
North Dakota					72,312	67,879	66,382	5,808	(1)	(1)	493,411	133,621
Ohio	(1)	(1)	258,044	54,494	1,807,360	1,220,046	3,085,107	1,786,631	2,788,582	1,109,650	14,250,141	9,182,862
Oklahoma	1,300	3,900	(1)	(1)	222,559	157,746	927,089	545,297	197,579	142,483	2,904,897	1,612,755
Oregon			(1)	(1)	486,100	347,344	940,884	608,053	250,215	89,692	2,257,338	1,508,787
Pennsylvania			(1)	(1)	2,966,015	3,107,532	1,848,278	2,292,593	(1)	(1)	12,674,320	13,658,328
Rhode Island					49,629	21,785	132,357	54,945			301,533	154,390
South Carolina	(1)	(1)	(1)	(1)	(1)	(1)	136,059	151,762	264,631	167,087	1,068,005	602,432
South Dakota			6,739	2,308	26,218	23,922	2,112,700	398,387	431,908	98,303	2,729,271	578,204
Tennessee			(1)	(1)	407,383	261,723	1,361,957	1,017,802	(1)	(1)	3,089,500	2,086,535
Texas	7,950	16,279	353,915	139,957	1,327,648	1,079,546	2,971,979	2,126,303	2,064,122	926,560	9,409,295	5,765,943
Utah			(1)	(1)	105,154	59,013	857,052	478,140	(1)	(1)	1,588,305	722,971
Vermont			10,676	4,859	4,320	4,596	13,221	6,459	(1)	(1)	170,301	58,879
Virginia			98,958	47,877	155,161	145,336	445,989	339,252	(1)	(1)	1,728,590	1,165,358
Washington			55,054	13,906	800,257	387,805	1,795,377	942,645	1,698,872	248,845	5,391,693	2,138,019
West Virginia			(1)	(1)	410,852	351,934	519,403	431,588	213,777	132,771	2,667,940	2,893,542
Wisconsin	(1)	(1)	(1)	(1)	1,123,842	481,522	3,880,484	2,110,533	1,806,477	501,140	10,727,632	4,574,182
Wyoming					(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed [2]	49,553	72,778	688,370	265,728	484,470	476,006	460,517	325,096	2,817,689	561,923	2,757,958	1,085,274
Average value	100,081	199,838 2.00	[3] 4,378,875	[3] 1,686,627 0.39	32,448,800	23,813,885 0.73	60,029,164	38,695,207 0.64	[4] 30,840,887	[4] 9,525,530 0.31	222,571,905	132,835,979 0.60

[1] Included under "Undistributed."
[2] Includes items entered as "(1)."
[3] Includes 2,505,408 tons of sand, valued at $703,891, used for railroad ballast, some sand used by the railroads and others for fills, bank widening, and stock-car bedding, and some miscellaneous material.
[4] Includes some gravel used by the railroads for fills and other purposes. The quantity of gravel reported as used exclusively for railroad ballast was 27,332,529 tons, valued at $8,804,082.

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Table 2.- Production of Quartz and Silica in the United States, 1923-1929 (1)

Commodity	1923			1924			1925			1926			1927			1928			1929		
	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton
Sand:																					
Glass sand	2,034,958	$ 3,751,778	$ 1.84	2,169,809	$ 3,718,973	$ 1.71	2,334,921	$ 3,836,085	$ 1.64	2,274,218	$ 3,615,371	$ 1.59	2,171,693	$ 3,257,790	$ 1.50	2,310,828	$ 3,435,645	$ 1.49	2,219,677	$ 3,788,471	$ 1.70
Molding sand	5,559,644	6,730,417	1.21	4,403,893	4,995,268	1.13	4,995,428	5,400,618	1.08	5,309,166	5,630,799	1.06	4,194,975	4,458,508	1.06	4,781,765	5,089,969	1.06	6,195,343	6,410,343	1.03
Building sand	39,234,762	23,751,224	.61	41,376,425	23,455,393	.57	45,287,240	26,306,463	.58	45,327,512	24,891,475	.55	40,737,377	22,198,767	.54	45,629,207	24,116,772	.53	41,161,013	23,309,238	.56
Grinding & polishing sand	1,456,039	2,361,695	1.62	1,756,058	2,707,583	1.54	1,824,449	2,525,180	1.38	1,859,215	2,504,514	1.35	1,686,762	2,193,690	1.30	1,538,046	1,991,962	1.30	1,636,464	2,303,652	1.40
Fire or furnace sand	307,794	445,479	1.45	237,143	291,175	1.23	343,716	392,932	1.14	434,541	460,967	1.06	410,801	452,835	1.10	305,659	362,044	1.18	440,679	483,551	1.09
Engine sand	2,033,494	1,535,638	.76	2,024,930	1,344,935	.66	2,261,635	1,395,890	.62	2,355,399	1,440,626	.61	2,618,890	1,640,736	.63	2,413,043	1,544,204	.64	2,318,931	1,487,906	.64
Paving sand	15,632,419	9,187,468	.59	20,707,875	11,595,499	.56	24,876,814	13,659,228	.55	27,476,998	14,970,906	.54	35,606,622	17,767,491	.50	35,244,544	17,305,750	.49	40,801,991	21,131,731	.51
Filter sand	116,520	139,671	1.20	74,828	150,239	2.01	106,462	249,141	2.34	79,382	169,299	2.13	74,674	155,137	2.08	113,978	226,896	1.99	100,081	199,838	1.99
Other sands	989,641	570,17-	.57	2,820,959	585,400	.21	5,151,557	1,382,788	.27	6,997,848	1,992,031	.28	6,086,545	2,166,444	.35	5,400,647	2,059,164	.38	4,378,875	1,686,627	.38
Gravel:																					
Building gravel	24,145,463	18,367,713	.76	30,486,874	22,718,803	.74	32,759,151	24,589,689	.75	30,535,396	22,701,685	.74	30,432,031	21,947,666	.72	34,747,235	24,071,208	.69	32,448,800	23,813,885	.73
Paving gravel	26,174,112	17,716,779	.67	28,830,336	18,773,832	.65	32,574,570	21,411,672	.65	38,319,064	25,445,025	.66	44,891,975	29,887,365	.67	49,088,786	30,697,993	.63	60,029,164	38,695,207	.64
Railroad ballast	22,247,307	6,345,597	.29	21,340,843	6,676,015	.31	19,485,530	6,392,437	.33	22,132,079	7,516,003	.34	28,541,924	9,403,357	.33	27,545,130	8,306,330	.30	30,840,887	9,525,530	.31
Quartz:																					
Vein quartz	20,601	193,630	9.40	23,761	203,177	8.55	25,444	205,376	8.07	27,743	274,336	9.88	22,144	194,040	8.76	22,198	209,333	9.43	20,981	205,759	9.80
Finely pulverized quarz	249,467	1,672,961	6.70	230,432	1,655,056	7.18	263,981	1,857,263	7.03	270,468	1,928,793	7.13	275,737	1,897,303	6.88	280,402	1,966,296	7.01	302,139	2,039,144	6.75
Abrasive quartz:																					
Millstones & burrstones	- -	22,229	- -	- -	30,125	- -	- -	22,490	- -	- -	45,937	- -	- -	35,438	- -	- -	42,886	- -	- -	31,407	- -
Grindstones & pulpstones	46,570	1,689,315	36.27	31,651	1,666,669	52.65	37,340	1,705,939	45.68	38,339	1,873,234	48.86	31,931	1,554,750	48.69	33,238	1,508,837	45.39	27,736	1,241,546	44.76
Oilstones & scythestones	1,223	231,812	181.36	1,056	258,943	245.21	970	272 224	280.64	1,680	223,359	132.95	1,048	233,545	222.85	956	228,245	238.75	838	212,017	253.00
Grinding pebbles & tube mill lining	4,551	51,795	11.38	2,532	37,429	14.78	3,831	50,147	13.08	6,219	85,146	13.69	3,342	46,856	14.02	6,288	89,321	14.20	4,630	66,178	14.29
Tripoli	27,082	382,757	14.13	28,476	389,409	13.67	29,388	434,886	14.79	31,369	523,609	16.69	26,099	447,068	17.13	34,034	555,576	16.32	38,011	545,658	14.35
Diatomite	65,833	699,406	10.62	63,163	693,917	10.98	73,030	922,281	12.62	87,126	1,081,564	12.41	(2)	(2)	- -	(2)	(2)	- -	(2)	(2)	- -

(1) Mineral Resources of the United States, Part II (Annual). (2) Bureau of Mines not at liberty to publish figures.

Table 4.- Imports of Quartz and Silica into the United States, 1923-1929 (1)

Commodity	1923			1924			1925			1926			1927			1928			1929		
	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton	Short tons	Value	Value per ton
Glass sand	2,309	$ 3,008	$ 1.30	6,479	$ 1,961	$ .30	4,186	$ 2,262	$ .54	8,817	$ 9,091	$ 1.03	10,665	$ 8,712	$ .82	43,137	$ 35,689	$ .83	- -	- -	- -
Other sand	276,493	157,125	.57	246,345	123,099	.50	305,769	141,655	.46	699,286	242,594	.35	411,797	189,527	.46	385,848	189,072	.49	988,370	$ 446,259	$ .45
Gravel	198,960	99,687	.50	448,586	155,146	.35	224,600	89,505	.40	239,476	90,226	.38	313,809	104,312	.33	359,237	167,350	.46	499,476	305,343	.61
Flint and flint stones	15,952	130,974	8.21	17,473	114,958	6.58	16,240	105.041	6.47	15,091	120,078	7.95	15,191	93,658	6.16	15,719	144,313	9.18	14,097	127,457	9.04
Millstones & burrstones:																					
Rough	(2)	17,214	- -	106	5,720	54.00	139	7,944	57.15	102	5,035	49.36	161	11,631	72.25	104	6,270	60.29	97	6,564	67.67
Bound	(2)	2,888	- -	6	591	98.50	2	469	234.50	50	1,231	24.62	22	1,095	49.77	2	84	42.00	- -	- -	- -
Grindstones	(2)	106,028	- -	2,855	122,440	42.89	2,625	124,319	47.36	2,253	120,335	53.41	2,001	134,804	67.36	1,773	114,874	64.80	1,882	119,264	63.37
Hones, oilstones and whetstones	(2)	53,233	- -	245	43,579	177.87	229	49,108	214.45	544	63,152	116.08	584	67,368	115.36	196	45,303	231.14	305	48,207	158.07
Diatomite, tripoli and rottenstone	(2)	11,779	- -	217	9,504	43.80	160	6,589	41.18	1,033	14,544	14.07	1,338	15,403	11.51	2,607	21,883	8.40	3,260	23,183	7.11
Brazilian pebble (rock crystal quartz)	47	7,862	167.28	2	547	273.50	- -	- -	- -	66	932	14.12	17	132	7.76	- -	- -	- -	- -	- -	- -

(1) Mineral Resources of the United States, Part II (Annual). (2) Bureau of Mines not at liberty to publish figures.

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Table 5.- Sand and Gravel Imported into the United States (1)

	1923		1924		1925		1926		1927		1928		1929	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Canada	399,252	$174,187	622,970	$221,627	463,930	$174,726	846,758	$272,729	622,872	$211,522	690,358	$261,805	1,539,883	$625,385
Cuba	- -	- -	- -	- -	193	204	728	986	- -	- -	- -	- -	- -	- -
Mexico	206	80	541	338	571	390	11,284	2,450	32,059	7,780	9,453	6,808	54,656	15,511
Brazil	326	8,450	- -	- -	441	7,092	- -	- -	- -	- -	58	2,666	- -	- -
Belgium	73,757	60,238	76,251	42,890	68,290	38,902	85,164	49,814	76,293	47,684	81,089	70,705	87,457	65,019
Denmark	- -	-	- -	- -	84	1,046	- -	- -	- -	- -	- -	- -	- -	- -
France	717	4,108	660	4,457	696	5,427	1,096	7,553	788	7,348	1,098	6,848	1,214	10,948
Germany	1,746	5,903	36	726	6	116	4	61	352	110	6	199	1,786	1,922
Italy	- -	- -	17	775	11	20	- -	- -	- -	- -	2	21	- -	- -
Netherlands	112	600	224	1,199	136	1,070	299	3,537	748	8,191	1,139	8,323	519	5,916
Sweden	- -	- -	4	15	- -	- -	273	244	- -	- -	29	159	- -	- -
United Kingdom	1,256	4,897	482	3,721	28	1,269	1,959	4,114	2,325	5,819	339	2,246	296	2,520
India	- -	- -	224	4,452	169	3,135	6	152	805	13,915	4,647	32,257	2,573	24,363
Japan	10	191	- -	- -	- -	- -	2	51	3	22	1	14	- -	- -
All others	380	1,166	1	6	(2)	25	6	220	26	160	3	60	1	18
Total	477,762	259,820	701,410	280,206	534,555	233,422	947,579	341,911	736,271	302,551	788,222	392,111	1,688,385	751,602

(1) Mineral Resources of the United States (Annual), Part II, Sand and Gravel. (2) Less than 1 ton.

Table 6.- Flint, Flints, and Flint Stones, Unground, Imported into the United States, in Short Tons (1)

	1923		1924		1925		1926		1927		1928		1929	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Argentina	- -	- -	(2)	$ 20	-	- -	- -	- -	- -	- -	- -	- -	11	$ 129
Belgium	2,012	$ 22,152	1,929	26,089	1,463	$ 23,547	1,680	$ 24,924	1,089	$ 14,513	969	$ 18,379	1,436	25,378
Canada	766	3,409	6	84	- -	- -	3	23	- -	- -	44	384	- -	- -
Czechoslovakia	32	484	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Denmark	3,908	43,886	3,681	33,892	2,284	21,494	3,454	39,120	3,148	24,812	6,716	74,595	3,365	34,160
France	8,955	57,401	11,636	53,080	12,309	59,247	9,475	52,522	10,953	54,307	7,816	49,190	9,157	66,327
Germany	226	2,572	184	1,497	1	16	- -	- -	- -	- -	20	447	78	1,192
Japan	(2)	5	- -	- -	32	358	- -	- -	- -	- -	- -	- -	- -	-
Norway	19	700	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Sweden	- -	- -	- -	- -	- -	- -	- -	- -	1	26	59	675	- -	-
United Kingdom	34	365	37	296	(2)	6	375	3,012	- -	- -	34	173	- -	- -
All others	- -	- -	- -	- -	151	373	104	477	- -	- -	61	470	- -	- -
Total	15,592	130,974	17,473	114,958	16,240	105,041	15,091	120,078	15,191	93,658	15,719	144,313	14,047	127,186

(1) Mineral Resources of the United States (Annual), Abrasive Materials. (2) Less than 1 ton.

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Tables 5 and 6 show the imports, by country of origin, of sand and gravel and of "Flint, flits, and flintstones, unground," for the same years.

Other than the sand and gravel imported from Canada, which is used mostly for building construction, the imports are glass sand, with Belgium the principal source. In recent years, however, Mexico has been shipping increasing amounts of sand and gravel into the United States.

The imports of "Flint, flints, and flint stone, unground" into the United States take the form of grinding pebbles. France, Denmark, and Belgium are the principal foreign sources for these stones. The pebbles imported from Denmark, however, come from Greenland and are shipped from that country to Denmark for cleaning and sorting. These pebbles are considered superior to those produced in the United States and are used in the grinding industry along the Atlantic seaboard, the stones from California being unable to stand the cost of the long freight haul east.

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